# Earth, Wind & Fire:
## *State Courts, Natural Disasters and the Insurance Industry's Response*

**National Center for State Courts**
**Insurance Webinar**
**March 27, 2024**


Robert P. Hartwig, PhD, CPCU
Clinical Associate Professor of Finance, Risk Management & Insurance
Darla Moore School of Business ♦ University of South Carolina
Robert.Hartwig@moore.sc.edu ♦ 803.777.6782

UNIVERSITY OF
SOUTH CAROLINA
Darla Moore School of Business

# A Short Primer on Catastrophe Models

## An Indispensable Tool for 21st Century Insurer Risk Management



2

# Catastrophe Modeling: A Brief History

- **Hurricane Andrew in 1992 resulted in the insolvency of ~11 insurers**
  - **Became very clear that (re)insurers need to improve their understanding of CAT risks**
  - **"Modern" computer-based, probabilistic CAT risk modeling has its origins in the late 1980s but was not widely adopted until post-Andrew**
  - **Made possible by the linking of scientific studies of natural hazard measurements and historical occurrences with advances in information technology geographic information systems**

- **Advancements in science (incl. climate science), engineering, IT, have greatly expanded the scope, accuracy and utility of CAT modeling over the past 30+ years. Risks now routinely modeled include:**
  - **P&C: Hurricanes, Tropical Storms, Earthquakes, Flood, Wildfire, Flood, Crop, Terrorism**
  - **L/H: Mortality, Longevity, Pandemic**

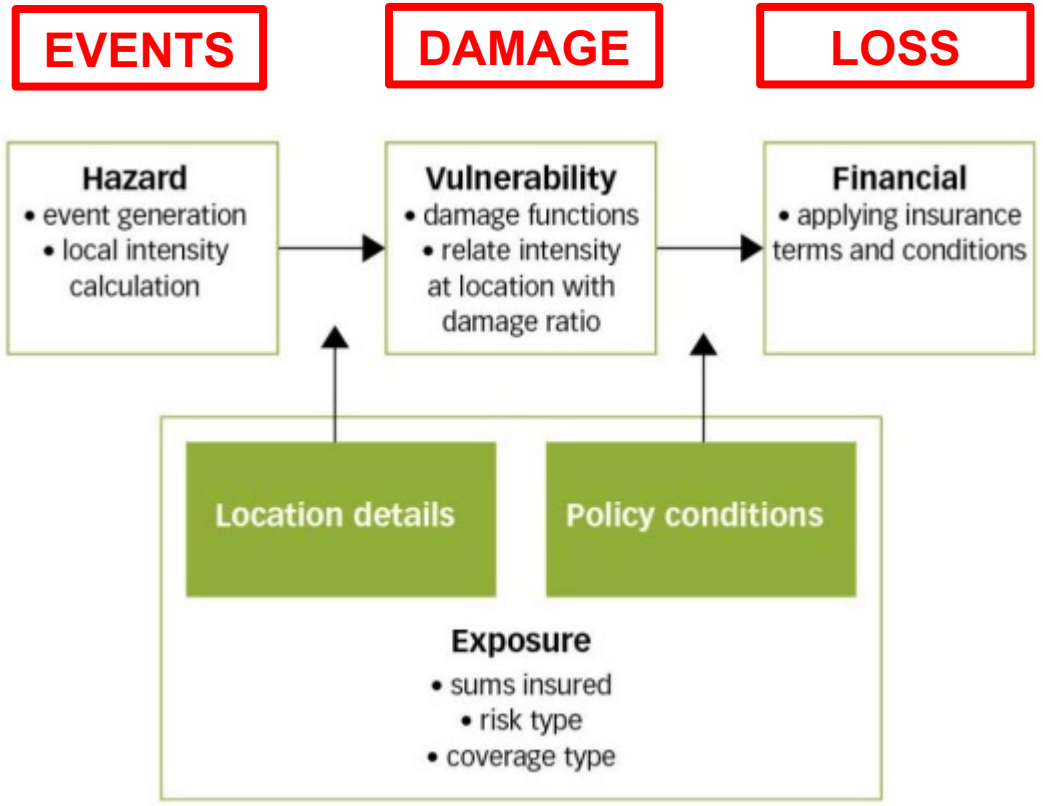
Source: Adapted from *The Review: Worldwide Reinsurance* and RMS: A Guide to Catastrophe Modelling; Accessed at: https://forms2.rms.com/rs/729-DJX-565/images/rms_guide_catastrophe_modeling_2008.pdf

# What Is a Catastrophe Model?

- **A computerized system that generates a robust set of simulated events and:**
  - **Estimates the magnitude/intensity and location of such events**
  - **Estimates the amount of damage**
  - **Estimates the insured loss**
- **CAT models are designed to answer:**
  - **Where future events are likely to occur**
  - **Expected frequency of events**
  - **Magnitude of potential events**
  - **Expected and/or potential insured losses**

Source: Adapted from CAS Fundamentals of Catastrophe Modeling; Accessed at: https://www.casact.org/sites/default/files/presentation/rpm_2010_handouts_cmwa-hess.pdf.

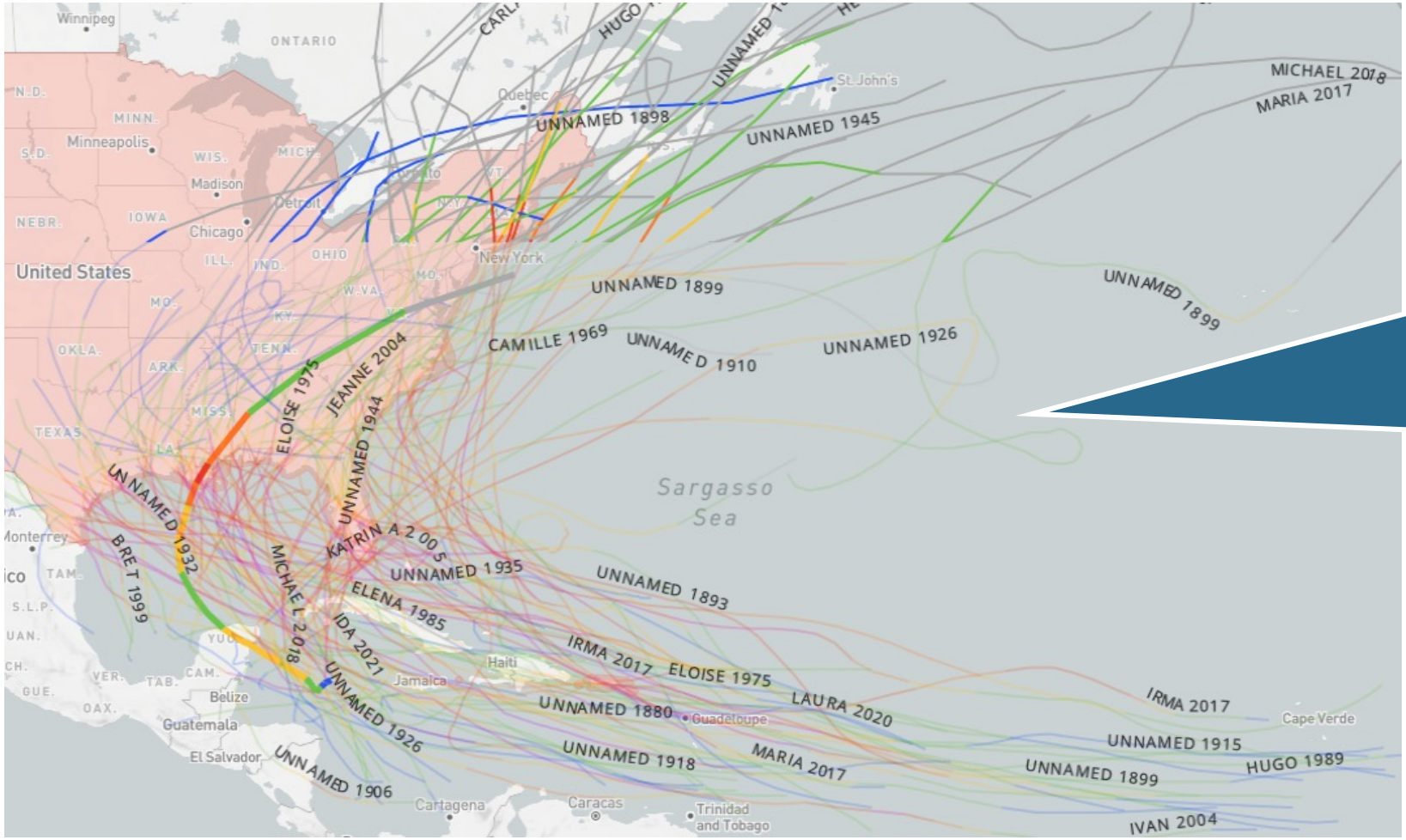
# How Does a CAT Model Work?




**CAT models require not only historical information on past events, but information on current exposures and policy terms & conditions**

Source: Adapted from Lloyd's, "Catastrophe Modelling and Climate Change accessed at: https://assets.lloyds.com/media/d6b6597a-092e-4e13-a31c-6983e215504e/pdf-modelling-and-climate-change-CC-and-modelling-template-V6.pdf; Risk and Uncertainty Management Center, University of South Carolina.

# Event Generation: Lots of Historical Information




**Tracks of all 147 CAT 3,4 and 5 hurricanes to make landfall in the US from 1842 – 2023.**

***Today, data like this can be gathered in minutes and used to estimate insurer exposure to severe tropical cyclone risks***

Source: Map generated from NOAA Historical Hurricane Tracks at: https://coast.noaa.gov/hurricanes/#map=4/32/-80; Risk and Uncertainty Management Center, University of South Carolina.

# Potential Uses for Catastrophe Models

- Ratemaking (rate level and rating plans)
- Portfolio management & optimization
- Underwriting/risk selection
- Loss mitigation strategies
- Allocation of cost of capital, cost of reinsurance
- Reinsurance/risk transfer analysis
- Enterprise risk management (ERM)
- Financial & capital adequacy analysis (rating agency)
- Securitization of CAT risk/Investor due diligence (e.g., CAT bonds and other ILS)

Source: Adapted from CAS Fundamentals of Catastrophe Modeling; Accessed at: https://www.casact.org/sites/default/files/presentation/rpm_2010_handouts_cmwa-hess.pdf.

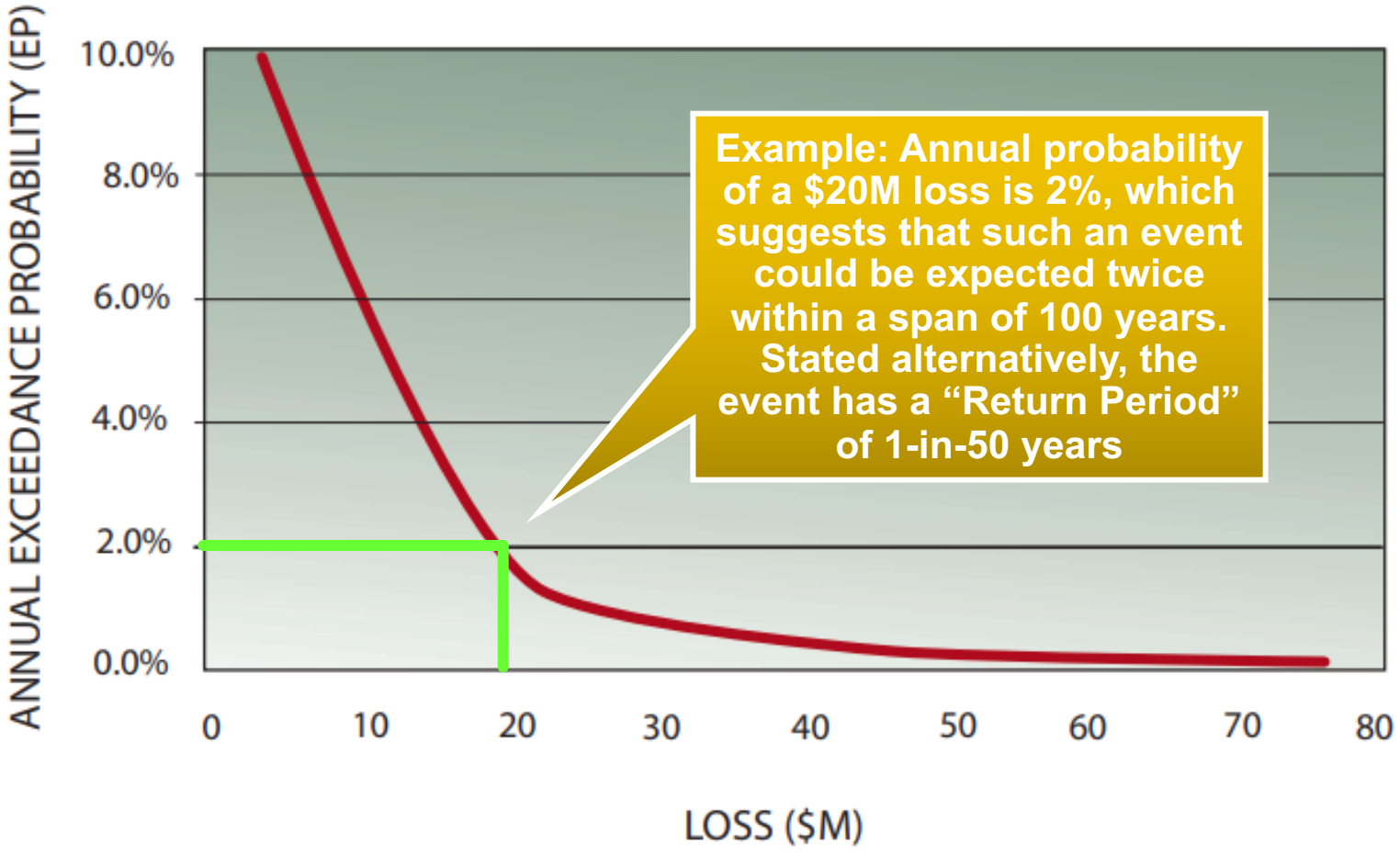
# Primary Output/Metrics from Catastrophe Models

- **Average Annual Loss (AAL): Expected Loss**
  - **AAL is an estimate of the annual premium necessary to cover losses from the modelled peril, over time**

- **Exceedence Probability (EP) Curve:**
  - **EP curve illustrates the annual probability of exceeding a certain level of loss**

Source: Adapted from CAS Fundamentals of Catastrophe Modeling; Accessed at: https://www.casact.org/sites/default/files/presentation/rpm_2010_handouts_cmwa-hess.pdf.

# Exceedance Probability (EP) Curve: Example




After running an EP analysis, the summary results are as follows:

| EP | RETURN PERIOD | LOSS AMOUNT ($M) |
|---|---|---|
| 0.02% | 5,000 | 76 |
| 0.10% | 1,000 | 57 |
| 0.20% | 500 | 48 |
| 0.40% | 250 | 40 |
| 1.00% | 100 | 28 |
| 2.00% | 50 | 20 |
| 10.00% | 10 | 4 |

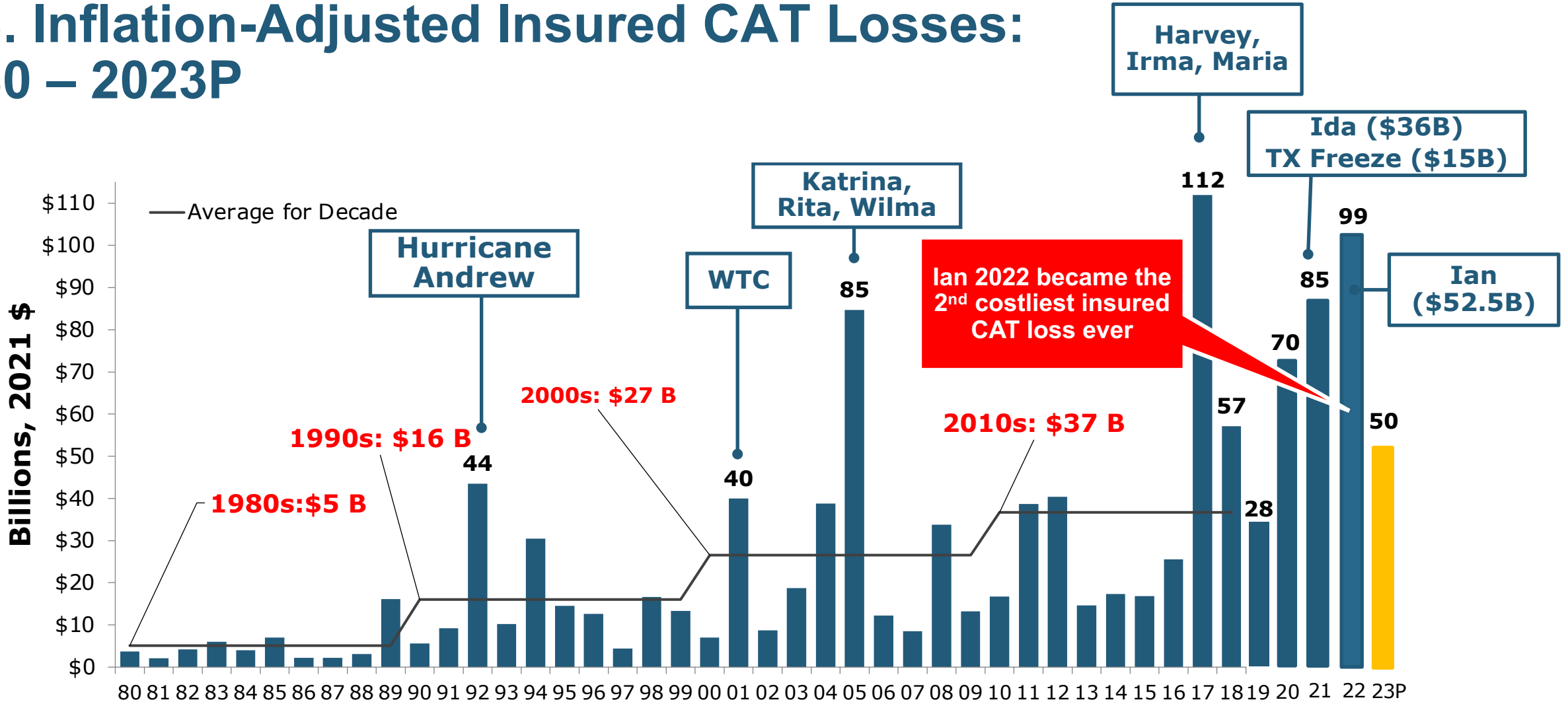
Source: Adapted from *The Review: Worldwide Reinsurance* and RMS: A Guide to Catastrophe Modelling; Accessed at: https://forms2.rms.com/rs/729-DJX-565/images/rms_guide_catastrophe_modeling_2008.pdf

# Catastrophe Loss Trends

## The Rise in CAT Losses Shows No Signs of Easing

## *The 2020s Are Off to an Ominous Beginning*

# U.S. Inflation-Adjusted Insured CAT Losses: 1980 – 2023P



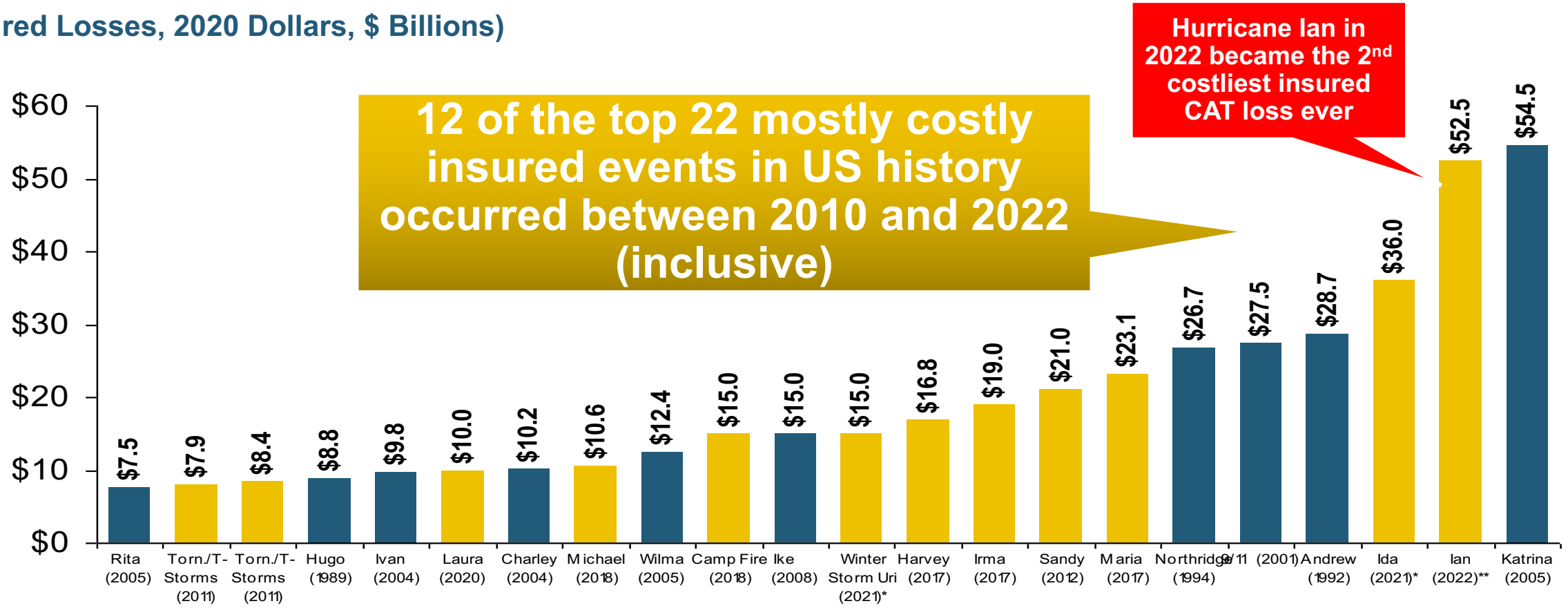

**Average Insured Loss per Year***
**1980-2021: $23.8 Billion**
**2012-2021: $44.1 Billion**

**The 2020s are off to an ominous start with $76B in average annual insured losses (2020-23P)**

*Stated in 2021 dollars except 2022 and 2023 (2022/23 dollars).
Sources: Property Claims Service, a Verisk Analytics business (1980-2019); 2020-23 figures from Munich Re; Insurance Information Institute; University of South Carolina, Risk & Uncertainty Management Center.

# Top 22 Most Costly Disasters in U.S. History

(Insured Losses, 2020 Dollars, $ Billions)

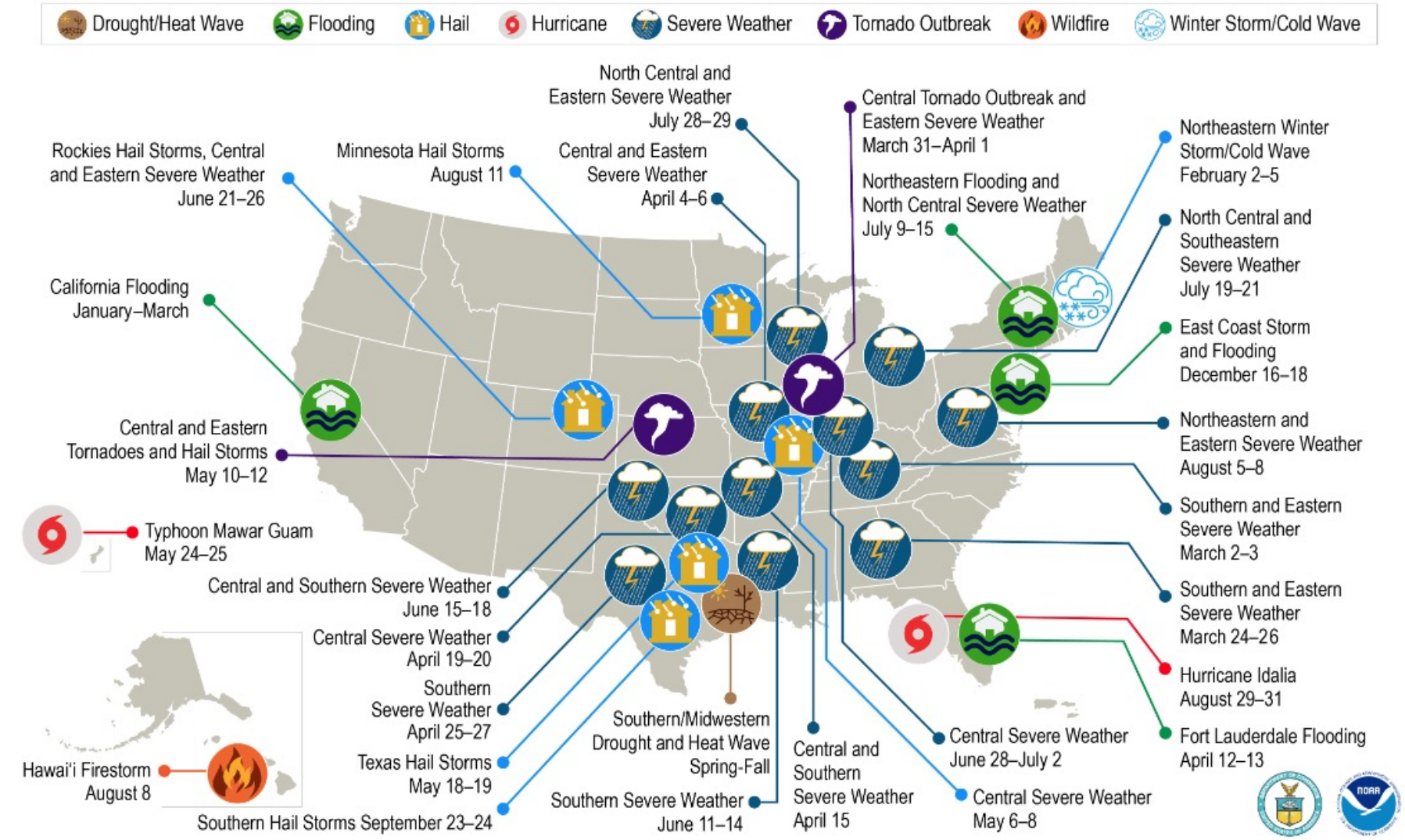



**18 of the 22 Most Expensive Insurance Events in US History Have Occurred Since 2004.**

*2021 dollars; **2022 dollars (Aon insured loss estimate as of 1/25/23).

Sources: PCS, RMS, Aon, Karen Clark & Co; USC Center for Risk and Uncertainty Management adjustments to 2020 dollars using the CPI.

# US Billion-Dollar Weather and Climate Disaster Events, Economic Costs, 2023

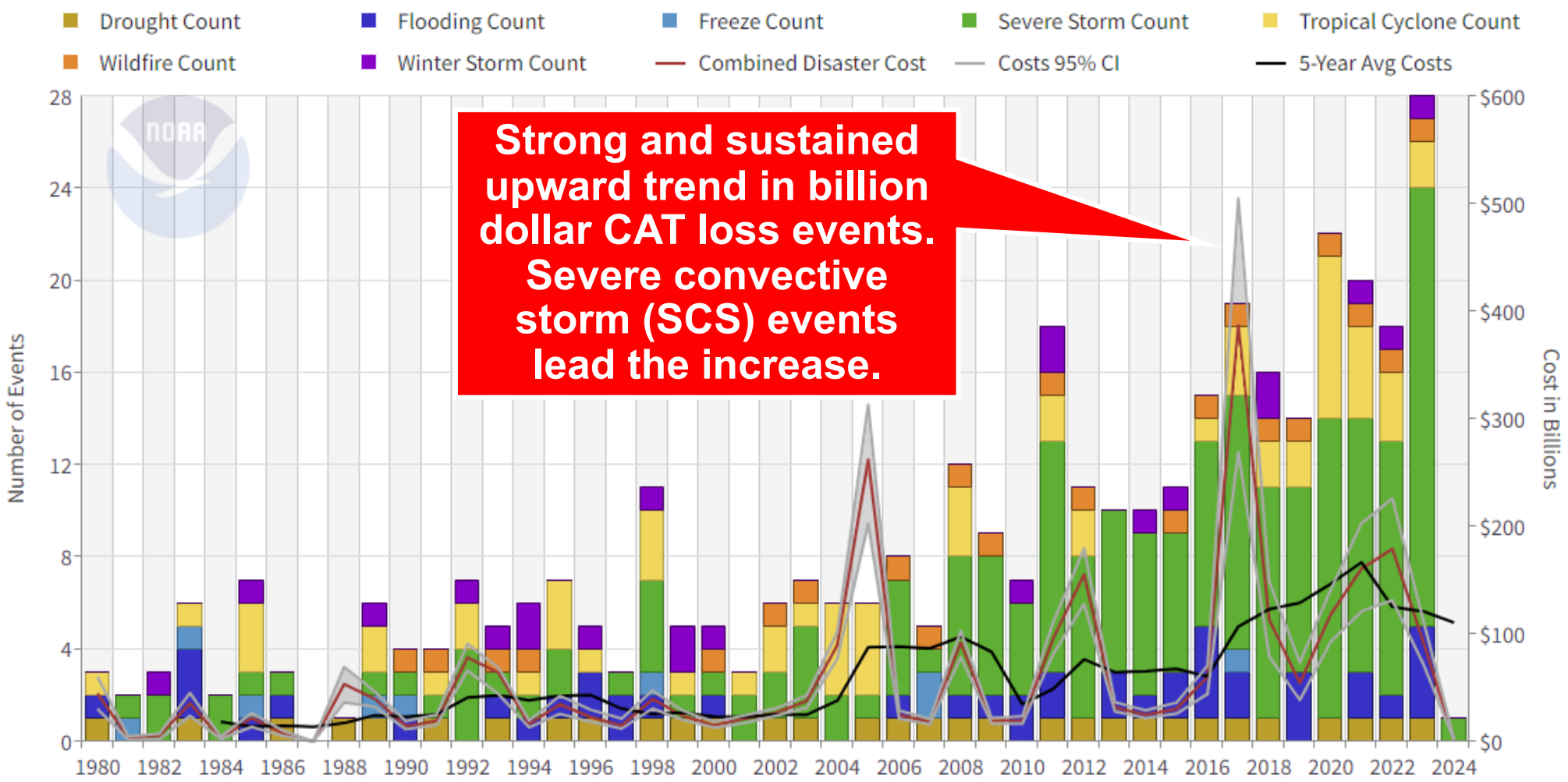



*This map denotes the approximate location for each of the **28 separate billion-dollar weather and climate disasters that impacted the United States in 2023.***

**There were a record 28 events in the US in 2023 that caused at least $1B in economic damage, up from 18 in 2022**

Source: NOAA, accessed at: https://www.ncei.noaa.gov/access/billions/time-series.

# US Billion-Dollar Weather and Climate Disaster Events, Economic Costs, by Type, 1980 – 2024* (CPI-Adjusted)




**Strong and sustained upward trend in billion dollar CAT loss events. Severe convective storm (SCS) events lead the increase.**

**Including forward-looking models that capture anticipated effects of climate changes should enhance model accuracy**

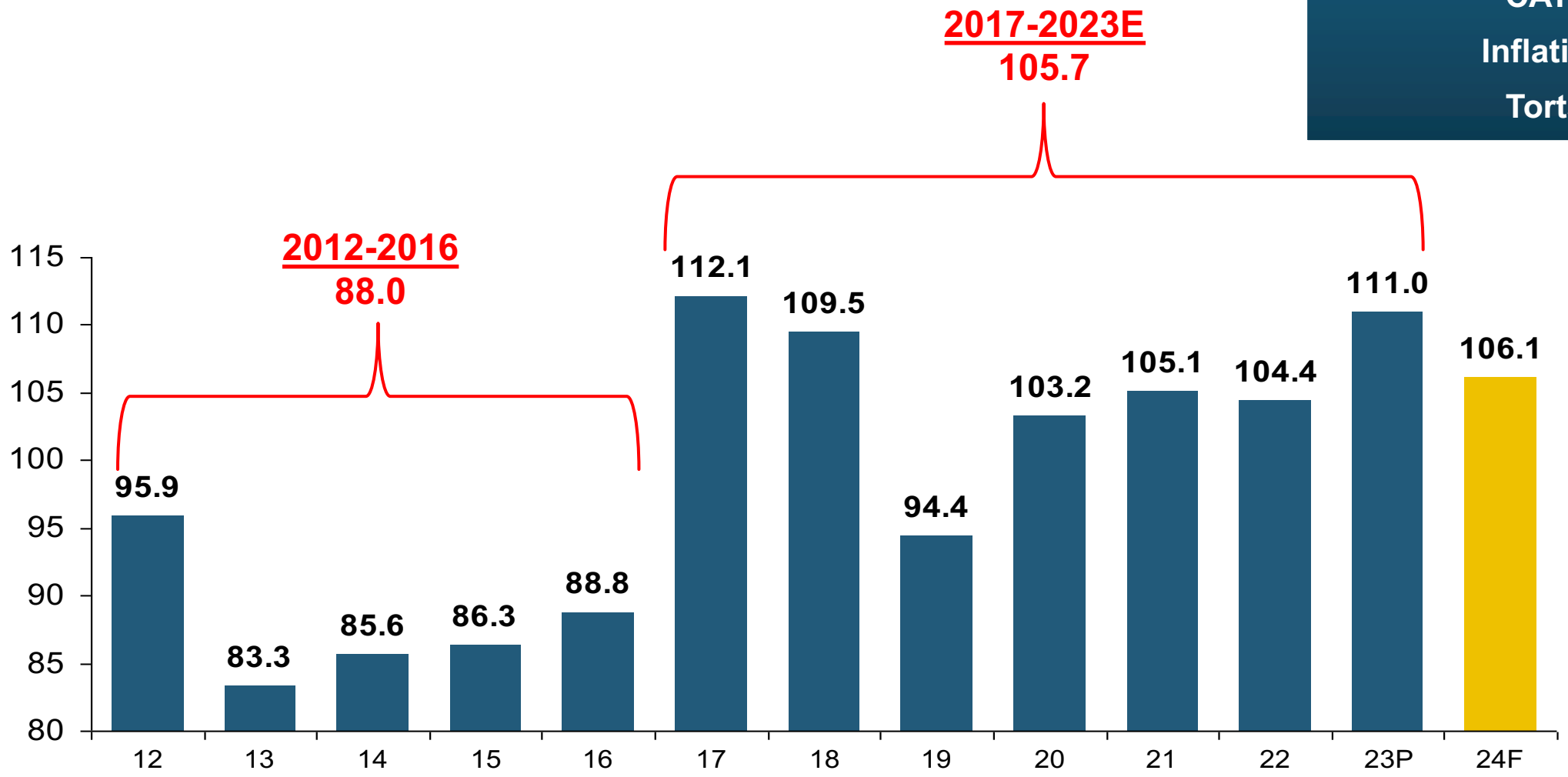
*As of March 8, 2024.

Source: NOAA. Chart created by USC Risk and Uncertainty Management Center by accessing: https://www.ncei.noaa.gov/access/billions/time-series.

# Homeowners Combined Ratio, 2012–2024F

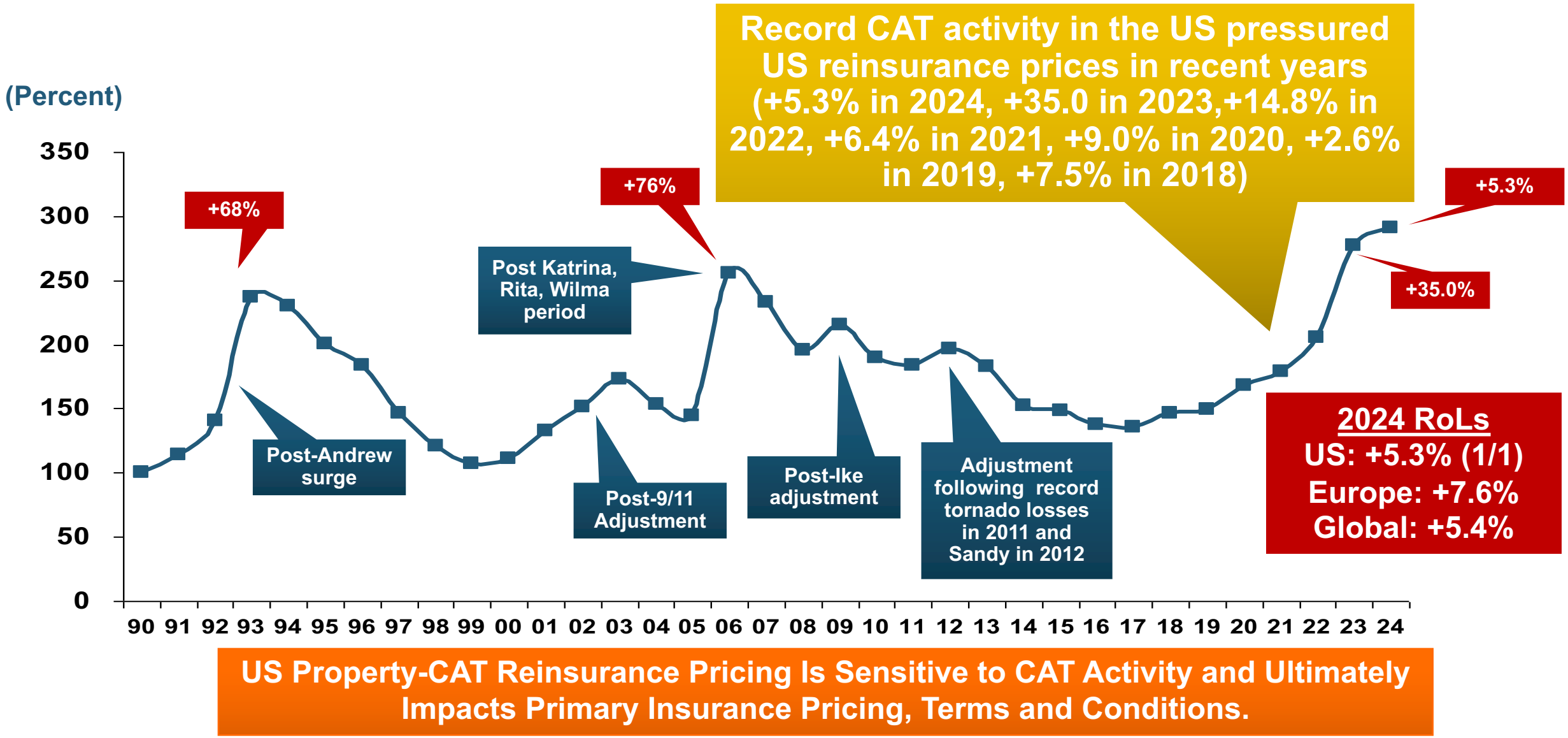
**Homeowners insurance results have deteriorated markedly since 2017, largely due to:**

- **CATs**
- **Inflation**
- **Torts**




Sources: A.M. Best (2016-2024F); Best's Review & Preview (March 2024).

# US Property Catastrophe Rate-on-Line Index: 1990 – 2024*




**US Property-CAT Reinsurance Pricing Is Sensitive to CAT Activity and Ultimately Impacts Primary Insurance Pricing, Terms and Conditions.**

*As of January 1 each year.

Source: Guy Carpenter; Artemis.bm accessed at: http://www.artemis.bm/us-property-cat-rate-on-line-index

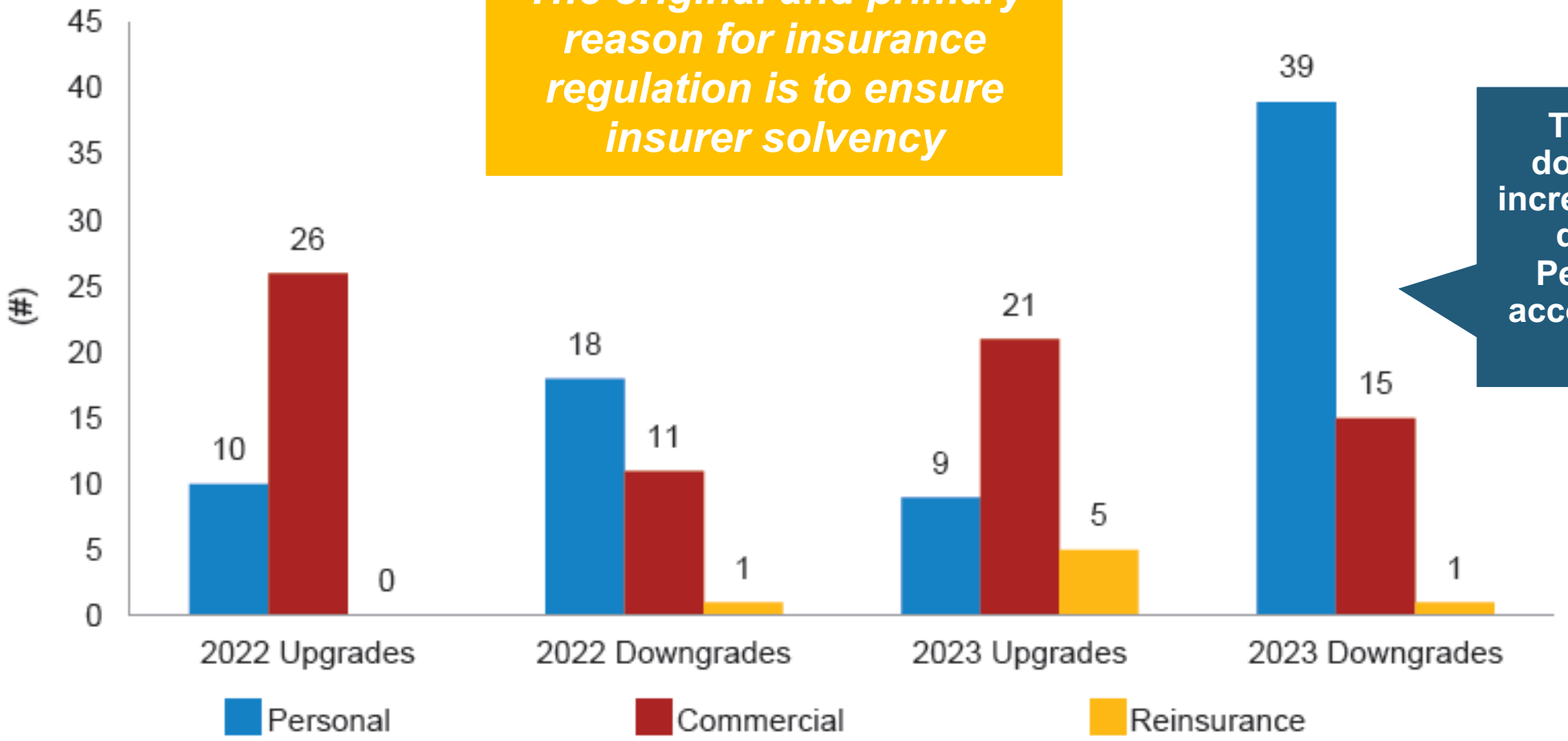
# Catastrophe Models Reduce Insolvency Risk

## The Original and Most Important Mandate of Insurance Regulators Is to Promote Insurer Solvency

***CAT Models Are an Indispensable Tool for Maintaining Market Stability and Capacity***

# US P/C: Rating Upgrades & Downgrades, by Segment, 2023

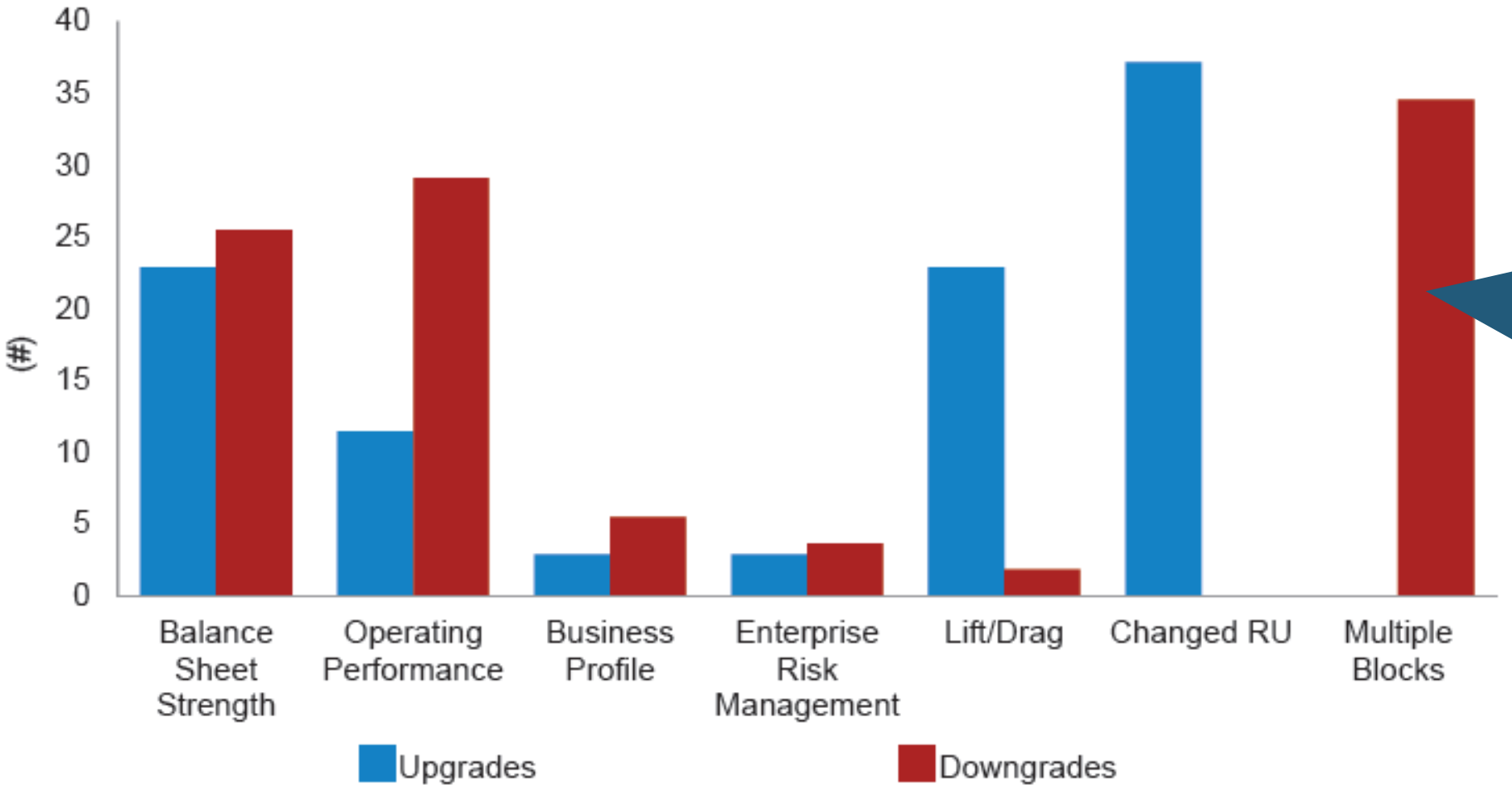
***The original and primary reason for insurance regulation is to ensure insurer solvency***




**There were 55 ratings downgrades in 2023, an increase of 83% from the 30 downgrades in 2022. Personal lines insurers accounting for most of the increase.**

Source: A.M. Best Review & Preview (March 11, 2024), *US Property/Casualty Downgrades Outpace Upgrades in 2023."*

# US P/C: Drivers of Rating Upgrades and Downgrades, 2023




**Most insurers downgraded in 2023 were downgraded for multiple reasons, though deteriorating balance sheet strength was a factor in all of the downgrades**

Source: A.M. Best Review & Preview (March 11, 2024), *US Property/Casualty Downgrades Outpace Upgrades in 2023."*

# Climate Risk and Litigation

## Litigation Arising from Meteorlogical Events Is Not New, But Litigation from Climate-Change Risks Is Both New and Different



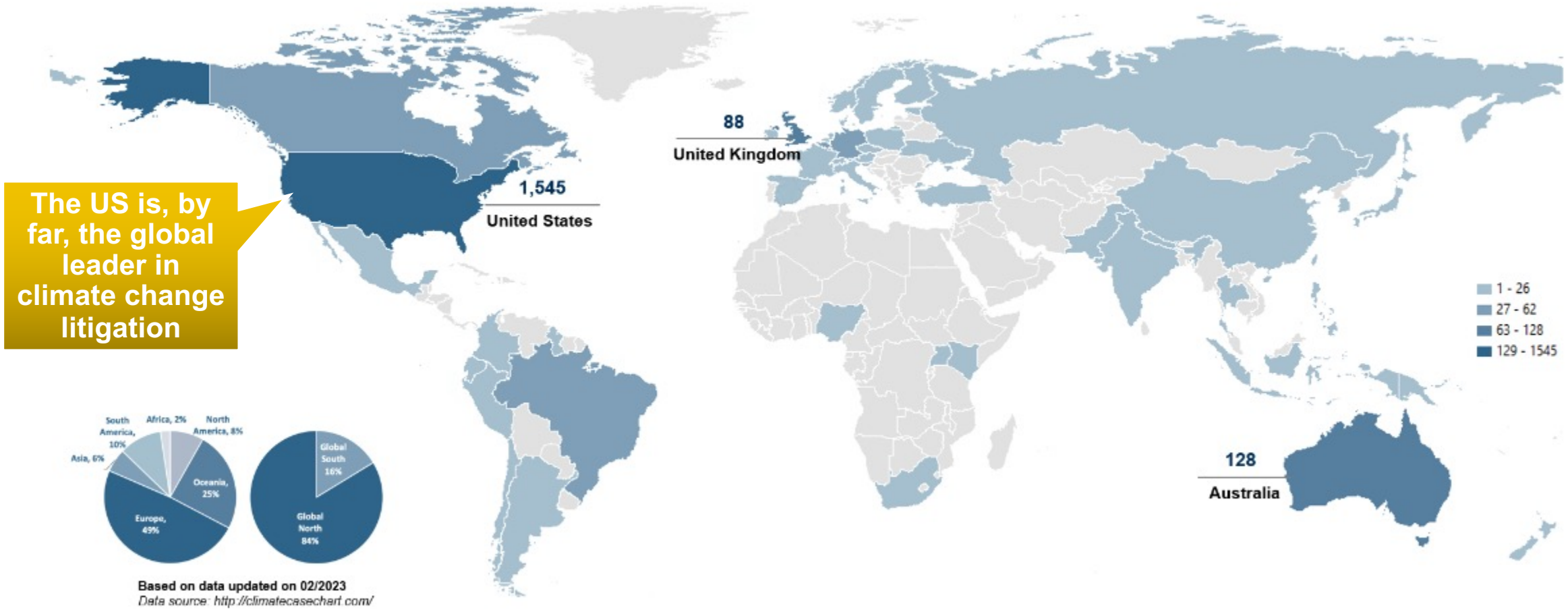
23

# Notable Climate Event-Related Litigation

- **Wind vs. Water Litigation**
  - Hurricane Katrina (2005)
  - Superstorm Sandy (2012)
- **Wildfire**
  - Dixie Fire (2021) and ensuing PG&E settlement (2023)
  - Camp Fire (2018), Wine country fires (2017) and PG&E settlement (2018)
  - Maui Wildfire (2023) and litigation against Hawaii Electric (arguing over jurisdiction)
- **Climate Change Impacts**
  - Aloha Petroleum v. National Union Fire Ins. Co. (2023)
  - Native Village of Kivalina v. ExxonMobil (2008; dismissed 2012)

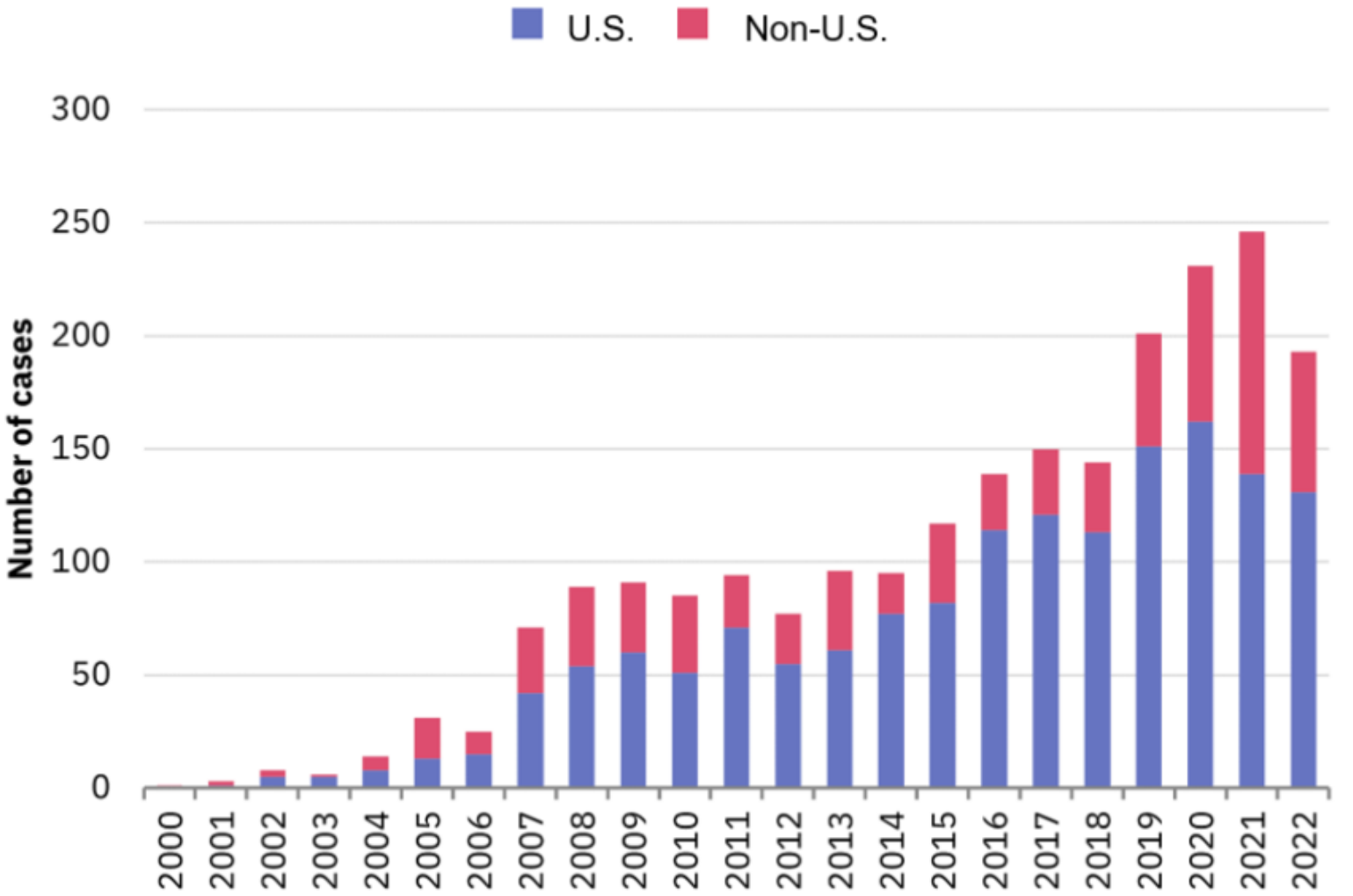
Source: University of South Carolina Risk & Uncertainty Management Center research and climatecasechart.com https://climatecasechart.com/case/aloha-petroleum-ltd-v-national-union-fire-insurance-co-of-pittsburgh/ and https://climatecasechart.com/case/native-village-of-kivalina-v-exxonmobil-corp/.

# Climate Change Litigation: Number of Legal Cases by Jurisdiction*




Source: http://climatecasechart.com/ as of Feb. 2023 as cited by Moody's/RMS, *Modeling Climate Change Litigation Risk: Impact on Liability Insurance: Focus on Directors & Officers Liability* (Feb. 2024).

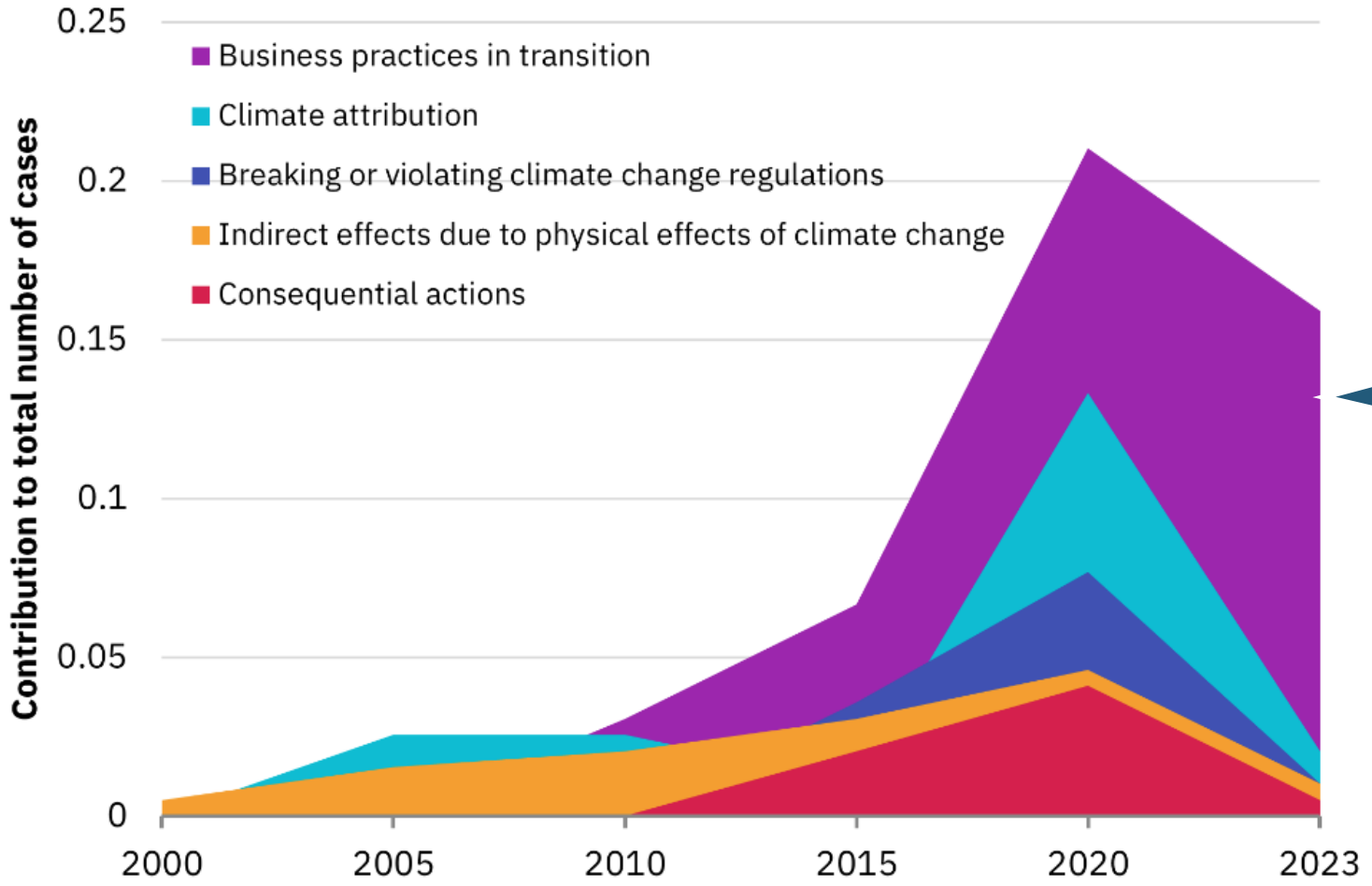
# Number of Climate-Change Litigation Cases Filed, 2000 - 2022




**The US has accounted for about 2/3 of climate-change litigation since 2000**

Source: http://climatecasechart.com/ as of Feb. 2023 as cited by Moody's/RMS, *Modeling Climate Change Litigation Risk: Impact on Liability Insurance: Focus on Directors & Officers Liability* (Feb. 2024).

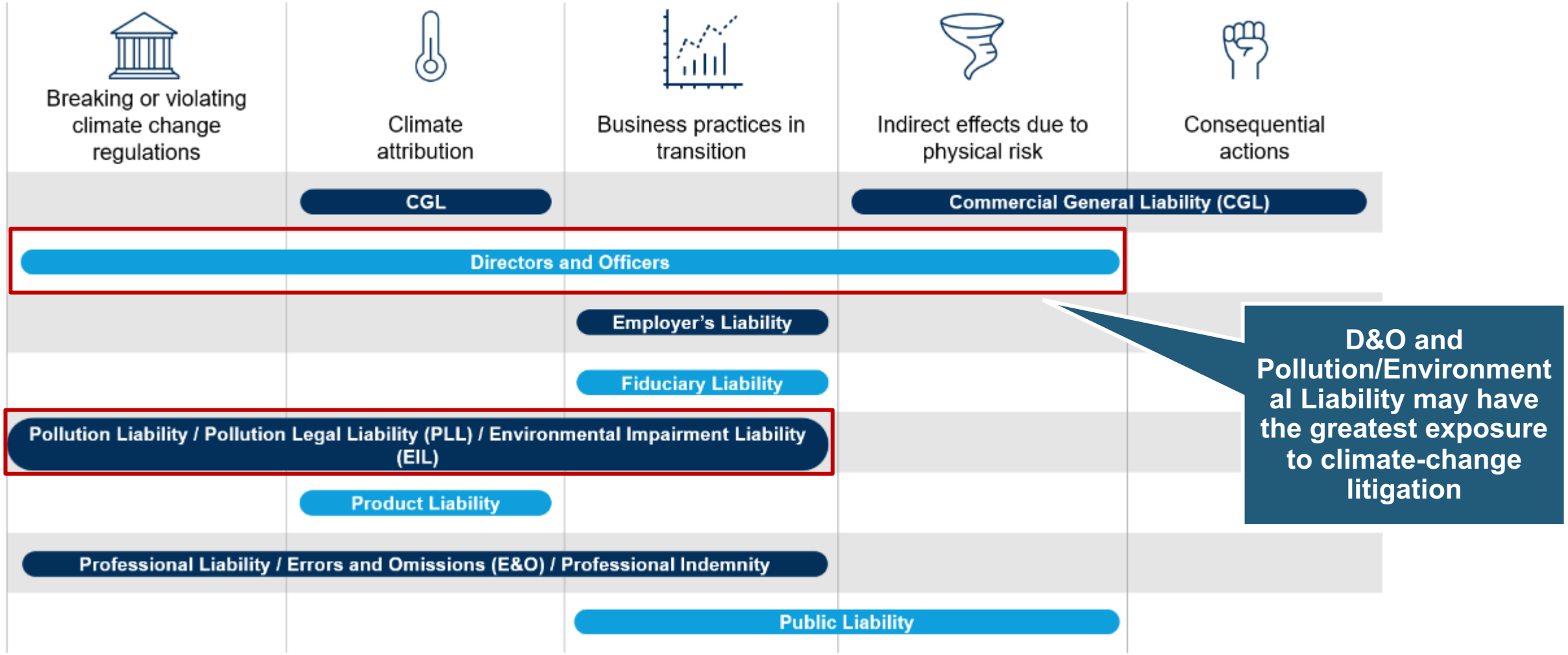
# Litigation Origin for Climate-Change Cases, 2000 - 2023




**Business Practices in Transition account for the majority of climate-related litigation. Examples in this category include the risk of stranded/ devalued assets and the failure to disclose or mitigate climate-related risks**

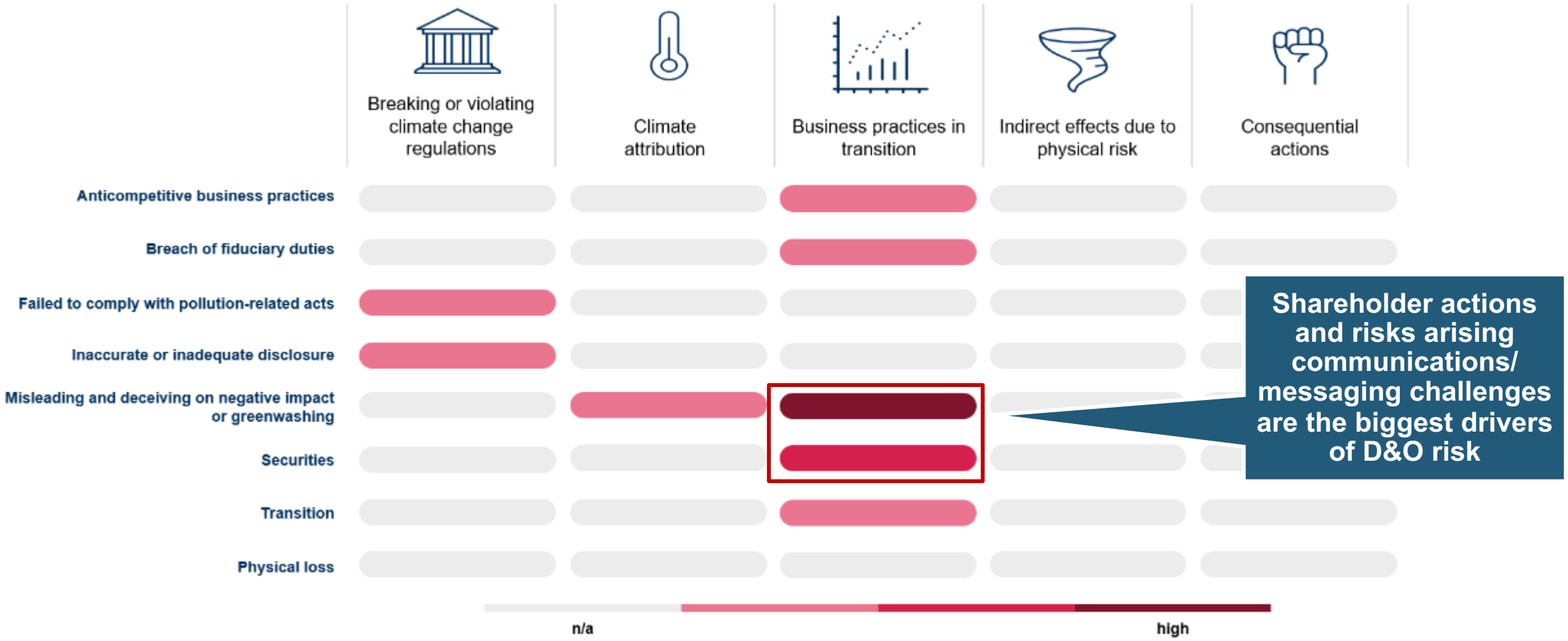
Source: http://climatecasechart.com/ as of Feb. 2023 as cited by Moody's/RMS, *Modeling Climate Change Litigation Risk: Impact on Liability Insurance: Focus on Directors & Officers Liability* (Feb. 2024).

# Liability Footprint by Type of Insurance Coverage



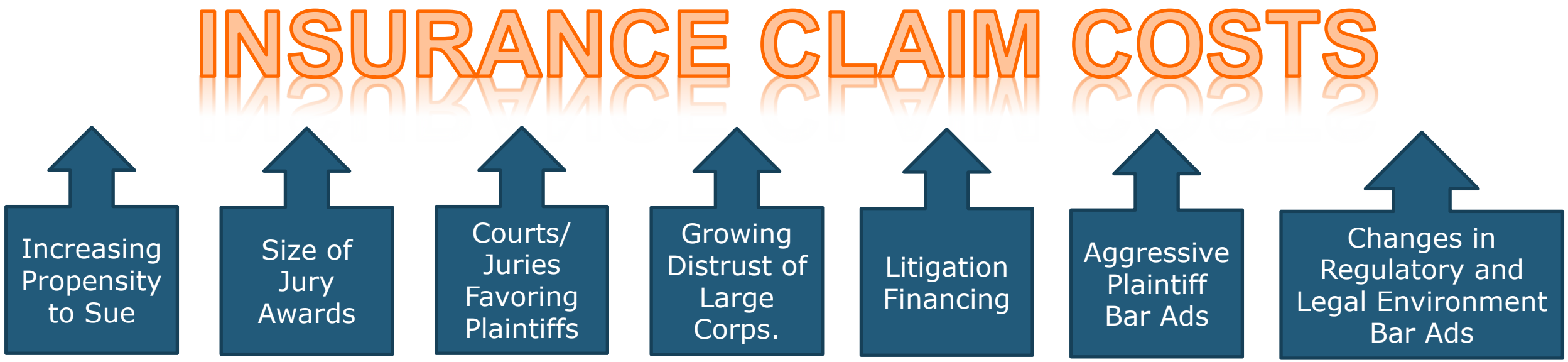

Source: http://climatecasechart.com/ as of Feb. 2023 as cited by Moody's/RMS, *Modeling Climate Change Litigation Risk: Impact on Liability Insurance: Focus on Directors & Officers Liability* (Feb. 2024).

# Key Loss Drivers for D&O Risk




Source: http://climatecasechart.com/ as of Feb. 2023 as cited by Moody's/RMS, *Modeling Climate Change Litigation Risk: Impact on Liability Insurance: Focus on Directors & Officers Liability* (Feb. 2024).

# Social Inflation: Many Interrelated Causes, Difficult to Manage




**Applied to a seemingly limitless number of issues, these drivers are pushing tort costs (and therefore claim costs upward)**

Source:Risk and Uncertainty Management Center, Univ. of South Carolina, adapted from Verisk “Social Inflation” presentation (2020).

UNIVERSITY OF
SOUTH CAROLINA
Darla Moore School of Business

***Thank you for your time and your attention!***

***Twitter: twitter.com/bob_hartwig***

***For a copy of this presentation, email me at robert.hartwig@moore.sc.edu or***

***Download at www.uscriskcenter.com***